year.[178] Of those, there were 1,150 that had employment of under 500, and an additional 37 that had employment of 500 to 999. The percentage of wireless equipment manufacturers in this category was approximately 61.35%,[179] so we estimate that the number of wireless equipment manufacturers with employment of under 500 was actually closer to 706, with and additional 23 establishments having employment of between 500 and 999. Consequently, we estimate that the majority of wireless communications equipment manufacturers that may be affected by our action are small entities.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

The terrestrial service operations authorized by this Order will be governed by new regulations that will be housed in Part 90 of our rules. There presently exists a general requirement for all equipment to obtain certification under Part 90.[180] Thus, as with other Part 90 equipment, we will require manufacturers to obtain similar certification for their equipment.[181] Consequently, the new equipment certification rules adopted for Part 90 in this proceeding for transmitters operating the 3650-3700 MHz band would apply similar reporting or recordkeeping requirements. Further, the regulations add permissible operating frequencies for broadband and other technologically advanced uses. The adopted regulations would not require the modification of any existing products. Additionally, rules adopted for use of the 3650 MHz band require that all applicants and licensees shall cooperate in the selection and use of frequencies in the 3650-3700 MHz band in order to minimize the potential for interference and make the most effective use of the authorized facilities.[182] A database identifying the locations of registered stations will be available at the FCC's website to facilitate such cooperation.

E. Steps Taken to Minimize the Significant Economic Impact on Small Entities, and Significant Alternatives Considered

The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities. 5 U.S.C § 603.

In the NPRM, the Commission proposed a regulatory scheme for the 3650 MHz band that would have permitted unlicensed use of the band. The NPRM also sought comment on alternative approaches, including those that would provide for licensing of terrestrial operations. Based upon comments to the NPRM and further analysis, this Order adopts an approach that provides for nationwide, non-exclusive licensed operations. Consistent with the underlying goals expressed in the NPRM, we believe that this approach will best provide for the introduction of a new variety of broadband services and technologies in

[178] U.S. Census Bureau, 1997 Economic Census, Industry Series: Manufacturing, "Industry Statistics by Employment Size," Table 4, NAICS code 334220 (issued Aug. 1999).

[179] *Id.* Table 5.

[180] *See* 47 C.F.R. § 90.203.

[181] *See* Order at ¶ 69 – 70, *infra*.

[182] *See* adopted new rule § 90.1319 (c) in Appendix A.

the 3650 MHz band, while protecting grandfathered FSS earth station operations from harmful interference that may be caused by the new services and technologies.

We see no evidence that the rules set forth in the *Report and Order and Memorandum Opinion and Order* will have a significant economic impact on small entities. The costs involved in the selection and use of frequencies by affected entities, including small entities, should be minimal because of the available on-line database to assist with these efforts. Furthermore, these minimal costs will be shared by all entities that use the 3650 MHz band. In particular, as noted in the Report and Order, the streamlined licensing approach should also reduce the costs and regulatory barriers to obtaining a license.[183]

F. Report to Congress

The Commission will send a copy of the *Report and Order and Memorandum Opinion and Order*, including this FRFA, in a report to be sent to Congress and the Government Accountability Office, pursuant to the Congressional Review Act.[184] In addition, the Commission will send a copy of the *Report and Order and Memorandum Opinion and Order*, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the *Report and Order and Memorandum Opinion and Order* (or summaries thereof) will also be published in the Federal Register.[185]

[183] *See, e.g., 3650 MHz Order* at ¶¶ 27-29.

[184] *See* 5 U.S.C. § 801(a)(1)(A).

[185] *See* 5 U.S.C. § 604(b).

APPENDIX C: List Of Parties Filing Comments And Replies

Abe Rahey
Abe Voelker
Adam Brodel
Alan Cain
Alex Huppenthal
Altazip Inc
Alyrica Networks, Inc.
American Petroleum Institute
Attron Networks - Tony Weasler
Bart Preecs
BigTube Wireless, LLC
Bo Hamilton
Boyd Goodin
Branch Run Communications
Brett Glass
Brevard Wireless
Bruce Collins
Bryan Fields
Butch Evans, BPS Networks
Carol Acuff
Carol Shirley
Chad Teat
Charles Wu
Chase Phillips
Christapher James Hasher
Clyde Messinger
Coalition of C-Band Constituents
Comsearch
Dan Nyanko
Darrin Eden
David Lawrence
David R Hughes
Don Irmiger
Don L. Marshall
Doug Hair
Electronic Corportae Pages, Inc Tushar Patel
Endless Mountains CyberSPACE
Eric Draven
Frank Muto
Geoffrey M. Silver
George Rogato
Gino Villarini
Greg Coffey
Hugh Hempel
IEEE 802
Industrial Telecommunications Association, Inc.
Intel Corporation
Intel Corporation
Jack Martin
Jack Unger
James M. McKinion
James P. Taylor
Jason Pottorf
Jason Straight
JC Randall
Jeffrey Sterling
Jerry Roy
Jim Martin
Joe Falaschi
John R. Worthington
John Stanton
John Thomas
John Vogel
Jon Langeler
Ken Walker
Kenneth DiPietro
Kevin Sullivan
Kewanee.com - Robert Bailleu
Kurt Fankhauser
Kurt Fankhauser
Laura Forlano
Lewey Taylor
MAP
Martin Moreno
Matthew R. Rantanen, Tribal Digital Village
Michael Boisse
Michael Falaschi
Michael J. Erskine
Michael Maranda
Michael Neuliep
Michiana Wireless - John Buwa
Mike Bushard Jr
Mike Dockstader
Mike Fennell
Motorola, Inc.
Motorola, Inc.
Mt. Vernon. Net, Inc. - John Scrivner
Nathan V Crook
Navini Networks, Inc.
Near You Networks - Rick Smith

Noah Miller
North Branch Consulting Group
North East Oregon Fastnet - Mark Koskenmaki
Northeast Texas Online, Inc.
NYCWireless, et al.
Odessa Office Equipment - Marlon K. Schafer
Old Colorado City Communications
OnlyInternet Broadband & Wireless, Inc. - Rick Harnish
PART-15.ORG
Paul Smith
Peter Palombella
Phil Kats
Philip Clever
Professor Christian Sandvig
Qorvus Systems, Inc. / Tom Sharples
R.J. Sussman
Richard Herrmann
Rick Mitchell
RNet Communications - William Edwards
Robert Trout
Rodney Lockhart
Ron Wallace
Sabryna Cornish
Sascha D. Meinrath
Satellite Industry Association
Satellite Industry Association
Satyanarayana Jasty
Sharon Schumacher
Skybeam - Matt Larsen
Southern Michigan Broadband, LLC - Eric Olmstead - President/CEO
Statewide Internet Services / Benjamin Winn
Stelios Valavanis
Sterling Jacobson
Stuart Pierce
Sue Sende Cole
Superior Wireless - Joe Laura
Thomas Harker
Tim Waite
Tropos Networks
Ty Carter
Vaxeo.com - Brad Armstrong
Very Fast Internet - Anthony Will
Virtual Network Services, Inc.
John Hokenson
Wireless Broadband Systems
Dan Metcalf
Michael Maranda
James L. Seibert Jr.
CUWIN, et al.
Tim Garthwaite
Stephen B. Ronan
Victor Pickard
J. Lynn
Donald K. Irmiger III
Sascha Meinrath
Robert Horvitz
Bruce Lai and Matthew Rubenstein
Matthew R. Rantanen/Southern California Tribal Digital Village
Laura Forlano
Haudy Kazemi
Peter Wainwright
Elaine Nelson
Chad Akins
Esmeralda Vos
Michael Keegan
Robert Keyes
Michael Keegan
Gary Sanders
John Cooper
Drew Celley
John Sundman
Valerie Scarlata
Andrew Ó Baoill
Darrin Eden
Steven White
Stelios Valavanis
Intel Corporation
Ursula Sindlinger
Bob Hrbek
CUWIN and Digital Tribal Village
NAF, et al.
TowerStream Corp. Bennet & Bennet, PLLC
Carol Shirley
Carol Acuff

APPENDIX D: A Methodology For Locating Fixed Stations Within The FSS Earth Station Protection Zone

The rules adopted herein require that fixed stations in the 3650-3700 MHz band be located at least 150 km from any grandfathered FSS earth station unless all affected licensees agree on closer spacing. Below, we present as an example, one methodology that can be used to determine a safe distance within the FSS earth station protection zone where a fixed station can be located without increasing the potential of that station to cause harmful interference to the earth station. We reiterate that this is being presented only as an example of one methodology. We recognize that there are many methods for providing the required protection, such as locating the fixed station behind an obstruction, and that licensees are free to propose any method they deem appropriate.

The 150 km protection zone is based on an analysis of the interference potential of a fixed station to a victim earth station under worst case operating conditions.[186] The methodology presented below recognizes that in most cases, the earth station does not operate in its worst case configuration. Using this fact, fixed stations can take advantage of the isolation provided by the higher elevation angles with which earth stations generally operate and transmit from locations within the protection zone without causing interference. This computed separation distance is based on the maximum level of interference noise power that may be caused to an FSS earth station.[187]

The Tables below show the assumptions and parameters used in our analysis:[188]

[186] As pointed out above, FSS earth stations must be protected for use of the full geostationary satellite arc. Thus, the worst case operating conditions are for a satellite operating at the extreme east or west edge of the arc with a 5° elevation angle.

[187] The methodology presented herein does not assume any discrimination due to the pointing of the fixed station antenna (*e.g.*, the fixed station could be pointed directly away from the earth station). Thus, for fixed stations that use directional antennas better results than those calculated here can be achieved.

188 The maximum level of interference noise power caused to an FSS earth station is based on the earth station antenna gain at an off-axis angle θ (degrees) referred to the main beam axis. This is measured from the axis of the main beam of the earth station.

Table 1: Typical FSS Earth station parameters

Earth Stations	3650-3700 MHz					
Antenna reference pattern[189]	47 CFR §25.209 (a)(2)					
Off-axis gain towards the local horizon (dBi)[190,]	Elev. Angle	5°	15°	25°	35°	≥48°
	Off-axis gain	14.5	2.6	–2.9	–6.6	–10.0
Receive Bandwidth (range)	40 kHz-36 MHz					
Receive center frequency	3675 MHz					
Polarization	Linear or circular					
Earth station system noise temperature[191]	142.8° K					
Deployment	All regions, in all locations (rural, suburban, urban)[192]					

Table 2: Fixed station parameters

Fixed stations	Parameters
Maximum transmit EIRP density	25 watts/25 MHz
Antenna type	Omni or directional

As mentioned, the methodology presented here takes advantage of the fact that earth stations are generally not operating in the worst case configuration. More specifically, we recognize that the elevation angle of an earth station varies in relationship to the position of the geostationary satellite with which it communicates.[193] Further, the range of pointing azimuths[194] and elevation angles that an earth station uses varies with its location – as earth stations are located at higher latitudes, the size of the visible

189 *See* recommendation ITU-R S.465. See also http://ntiacsd.ntia.doc.gov/ussg1/temp/TG1-8/052e+plen.doc.

The antenna radiation pattern in the plane of the horizon set forth in Section 25.209(a)(2) of our rules for earth stations pointing towards the geostationary arc is:

$32-25*\log 10\ (\theta)$ dBi, for $1 \leq \theta < 48°$.

-10 dBi, for $48° \leq \theta \leq 180°$.

190 The values were derived by assuming a local horizon at 0° of elevation. Note that the off-axis antenna gain is independent of the earth station antenna diameter.

191 See SIA comments at 3 of Exhibit 1. The maximum interference permitted at the earth station receiver input is measured in terms of an increase to the earth station noise floor. An interference criterion typically used to quantify the amount of interference that can be tolerated by a satellite system or an earth station is known as the $\Delta T/T$ threshold. This criterion is related to the increase in system noise temperature and corresponds to the interference-to-noise ratio, I/N, (*i.e.*, 10 log ($\Delta T/T$)).

192 FSS ES antennas in this band may be deployed in a variety of environments: smaller antennas (*e.g.*, 1.8m -3.8m) are commonly deployed on the roofs of buildings in urban or semi-urban locations , whereas larger antennas (4.5m and above) are typically mounted on the ground and deployed in semi-urban or rural locations.

193 All geostationary satellites are located approximately 36,000 km above the equator at 0° latitude.

194 Azimuth is measured by using true north as the reference point. Thus an azimuth of north is 0°, east is 90°, south is 180°, and west is 270°.

geostationary arc decreases limiting the available azimuth angles and the elevation angles necessary to see these satellites gets lower.[195]

In the next sections, we will show how to calculate the minimum separation distance between a single fixed station and a single FSS earth station. Finally, we provide an example calculation of the minimum separation required separation distance of a fixed station from several FSS earth stations.

Section 1: Determine the MINIMUM separation distance between a single fixed station and a single FSS Earth station.

Several steps are necessary to determine the minimum separation distance between a fixed station and an FSS earth station. To make this calculation, the first step is to determine the location of the eastern and western limits of the visible geostationary arc for any given the fixed station location. Then, a calculation can be made to determine the discrimination angle (*i.e.*, off-axis angle) between the axis of the main beam of the earth station and the fixed station. Using this value, the earth station antenna gain in the direction of the fixed station can then be calculated. Finally, the minimum distance can be calculated.

Step 1: Determine the eastern and western limits of the visible geostationary arc for any FSS earth station. As previously stated, this corresponds to an earth station with a 5° elevation angle

The elevation angle of an earth station can be calculated using the following formula: [196]

$$El = \arctan\left[\frac{\cos(\Delta) * \cos(Le) - 0.1512}{\sqrt{1 - \cos^2(\Delta) * \cos^2(Le)}}\right]$$

Equation 1[197]

Where:

El = Earth station elevation angle in degrees

Le= Earth station latitude in degrees

Δ =S-N

and

S = Satellite longitude in degrees

N= Earth station longitude in degrees

Rearranging Equation 1, yields:

$$\cos^2(\Delta)\cos^2(Le)(1+\tan^2(El)) - 2(0.1512)\cos(\Delta)\cos(Le) + (0.1512)^2 - \tan^2(El) = 0;$$

Equation 2

[195] For example, a typical earth station located at 25° north latitude has range of elevation angles between 5° and 66°. In contrast, an earth station located at 76.3° north latitude can only see one satellite at a maximum elevation angle of 5 degrees, corresponding to 180 azimuth.

[196] The equations used in this analysis assume North latitude and West longitude.

[197] Douglas, Robert L. "Satellite Communications Technology". Prentice Hall Publishers. Englewood Cliffs, NJ, 1988, pg 89.

If we let $X = \cos(\Delta)\cos(Le)$, then

$$S = \arccos\left(\frac{X}{\cos(Le)}\right) + N$$

Where:

S = the westernmost satellite longitude visible to an earth station operating at 5° elevation angle.

Then Equation 2 simplifies to a quadratic equation:

$a*X^2 + b*X + c = 0$[198] Equation 3

Where:

$a = (1+\tan^2(El))$;

$b = -2(0.1512)$;

$c = (0.1512)^2 - \tan^2(El)$

The practical root, X_1, of equation 3 can then be used to determine the deviation from the earth station longitude that defines the eastern and western limits of the visible geostationary arc.

If we let $W = \arccos\left(\frac{X_1}{\cos(Le)}\right)$

Where W = deviation from earth station longitude that defines visible geostationary arc

Then the visible geostationary arc is:

$(N - W) \leq \text{visible Arc} \leq (N + W)$

Where: (N – W) and (N + W) are the easternmost and westernmost satellite longitudes visible to an earth station operating at 5° elevation angle.

[198] This is solved using the quadratic formula to yield two roots X_1 and X_2

$X_1 = (-b + \mathrm{sqrt}(b^2 - 4ac))/2a$;

$X_2 = (-b - \mathrm{sqrt}(b^2 - 4ac))/2a$; this root is rejected because it provides a solution for a negative elevation angle.

This result can be converted from degrees longitude to a corresponding azimuth angle from true North. These azimuth angles are used in the steps that follow.[199]

$$Azimuth = 180 + \arctan\left[\frac{\tan(\Delta)}{\sin(Le)}\right]$$

Thus, the visible geostationary arc is:

$$180 + \arctan\left[\frac{\tan(-W)}{\sin(Le)}\right] \leq \text{Visible Arc} \leq 180 + \arctan\left[\frac{\tan(W)}{\sin(Le)}\right]$$

Step 2: Determine the angle between the axis of the main beam of the earth station and the fixed station (*i.e.*, off-axis angle, θx). This angle is calculated using the formula:[200]

$$\theta x = \arccos\left(\cos(El) * \cos(As - Af)\right) \qquad \text{Equation } 4^{201}$$

Where:

θx: off-axis angle[202];
El: Earth station elevation angle
As: Azimuth from earth station towards the satellite
Af: Azimuth from earth station towards the fixed station

Step 3: Determine the earth station antenna gain that corresponds to the value of θx.

$$Gd = 32 - 25 * \log(\theta x) \qquad \text{Equation 5}$$

Where:

Gd = earth station antenna gain in the direction of the fixed station

[199] Douglas, Robert L. "Satellite Communications Technology". Prentice Hall Publishers. Englewood Cliffs, NJ, 1988, pg. 91.

[200] The earth station antenna discrimination angle between the its pointing vector (*i.e.*, direction towards a satellite) and its local horizon in the direction of the fixed facility can be determined using vector dot products and spherical geometry. Dot product is defined by the equation: Dot(A, B) = ||A||*||B||*cos(θx). For the smooth earth case, the relationship reduces to cos(θx) = cos(EL)*cos(As – Af).

[201] The 150 km protection zone is based on a worst case scenario. This occurs when the axis of the main beam of the fixed station points directly towards the axis of the main beam of the earth station. In this scenario, As = Af and the off axis angle θx becomes equal to the earth station elevation angle, El. We note that in order for this worst case to occur, two independent stations would need to be perfectly aligned. Therefore, we believe the likelihood of this occurring to be very small.

[202] This is often referred to as the discrimination angle.

Step 4: Calculate the minimum separation distance required between the earth station and the fixed station based on the fixed station location and the earth station antenna gain in the direction of the fixed station.

$$Mfx = 18.17 * Exp^{(-0.055 * Gd)} \quad \text{Equation 6}$$

Where:

Mfx = variable accounting for all propagation losses other than free space (*e.g.*, multipath, etc.)[203]

Finally,

$$Dx\ (km) = \frac{150}{10^{\left[\frac{(-0.724 + Gd - Mfx)}{20}\right]}} \quad \text{Equation 7}$$

Where:

Dx = minimum separation distance in kilometers

Section 2: Example Calculation OF MINIMUM SEPARATION DISTANCE BETWEEN A FIXED STATION AND MULTIPLE EARTH STATIONS

This example assumes a fixed station located within 150 km of four earth stations.[204] The fixed station has an omnidirectional antenna and is located at 37° north latitude and 80° west longitude. It is assumed that the earth stations are located at the following coordinates.

Earth Station1: 38° North latitude; 80° west longitude - 111.20 km from fixed station

Earth Station2: 37° North latitude; 81° west longitude - 88.80 km from fixed station

Earth Station3: 36° North latitude; 80° west longitude - 111.20 km from fixed station

Earth Station4: 37.15° North latitude; 81° west longitude - 90.27 km from fixed station

203 This term was created as a simplification of all the factors that account for propagation loss. It is a conservative estimation of loss based solely on the off axis discrimination angle (*i.e.*, the lower the elevation angle the greater the loss). This equation yields results consistent with the propagation model used by SIA in the analysis submitted in their comments.

204 The great circle distance, D, between two points with coordinates {lat1, lon1} and {lat2, lon2} is given by:

D (km) = 6371* arccos(sin(lat1)*sin(lat2)+cos(lat1)*cos(lat2)*cos(lon1-lon2))

Using the approach described above, the full arc in azimuth for each earth station is:

Earth Station1: 100.95° ≤ Full Arc ≤ 259.05°

Earth Station2: 100.56° ≤ Full Arc ≤ 259.44°

Earth Station3: 100.17° ≤ Full Arc ≤ 259.83°

Earth Station4: 100.61° ≤ Full Arc ≤ 259.39°

The azimuth angle from each earth station to the fixed station can be computed:[205]

Earth Station1 Azimuth = 180 degrees;

Earth Station2 Azimuth = 90 degrees;

Earth Station3 Azimuth = 0 degrees.

Earth Station4 Azimuth = 100.35 degrees.

Now, the earth station off-axis angle can be calculated using equation 4:

Earth Station1 θx = arcos (cos(5)*cos(180-100.95)) = 79.09 degrees.

Earth Station2 θx = 11.67 degrees

Earth Station3 θx = 100.13 degrees

Earth Station4 θx = 5.0 degrees

Using the off axis angle, the antenna gain towards the fixed station is given by equation 5.

Earth Station1 Gd = -10 dBi

Earth Station2 Gd = 5.32 dBi

Earth Station3 Gd = -10 dBi

Earth Station4 Gd = 14.53 dBi

[205] Except for earth station4, the azimuth angles can be determined by inspection. In general, the following equations can be used to determine azimuth angle between two points:

phi = arcos((sin(lat2) - sin(lat1)*cos(D)) / (sin(D)*cos(lat1))); where D is the great circle distance between the two points under consideration

IF sin(lon2-lon1) < 0, Az = phi

IF sin(lon2-lon1) > 0, Az = 2*pi – phi

Note: these equations do not work if one point is located at the north or South Pole.

The corresponding separation distances can be determined by equations 6 and 7:

Required separation distance to Earth Station1, D1 = 37.45 km

Required separation distance to Earth Station2, D2 = 84.56 km

Required separation distance to Earth Station3, D3 = 37.45 km

Required separation distance to Earth Station4, D4 = 150 km

Finally, the required separation distance must be compared to the actual separation distance to ensure adequate protection of the earth station:

Earth Station1, D1 = 37.45 km < 111.20 km

Earth Station2, D2 = 84.56 km < 88.80 km

Earth Station3, D3 = 37.45 km < 111.20 km

Earth Station4, D4 = 150 km > 90.27 km

Therefore, the fixed station is sufficiently far from Earth Stations 1, 2, and 3 to provide interference protection. However, unless an agreement is negotiated, it cannot be located at its proposed location because it is not at a sufficient distance from Earth Station4 to provide the required interference protection.

Calculate the PROTECTION zone around an earth station

Using the methodology presented in this Appendix, a protection zone for an earth station smaller than the 150 km circle adopted in our rules can be calculated. To compute this protection zone, the equations of Section 1 can be solved iteratively for incremental values ranging from 0 to 360 degrees of the fixed station azimuth angle (Af). The figure shown below is an example of the calculated protection zone around an earth station located at 49° north latitude and 120° west longitude.[206] It is important to note that the earth station location used for this example is in the northern part of the U.S.[207] For more southern locations, the minimum separation distance at azimuths directly in front and back of the earth station would be smaller.

[206] The computed visible geostationary satellite arc ranges from -51.1° east longitude to 188.89° west longitude.

[207] This location was chosen for illustrative purposes only and does not imply that there is a grandfathered earth station at this location.

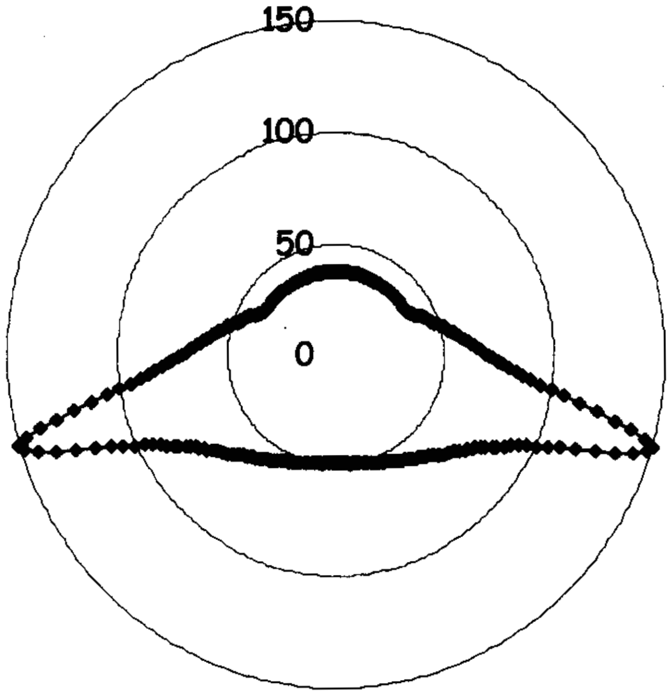


Figure: Earth Station Protection Zone

APPENDIX E: List Of Grandfathered FSS Earth Stations

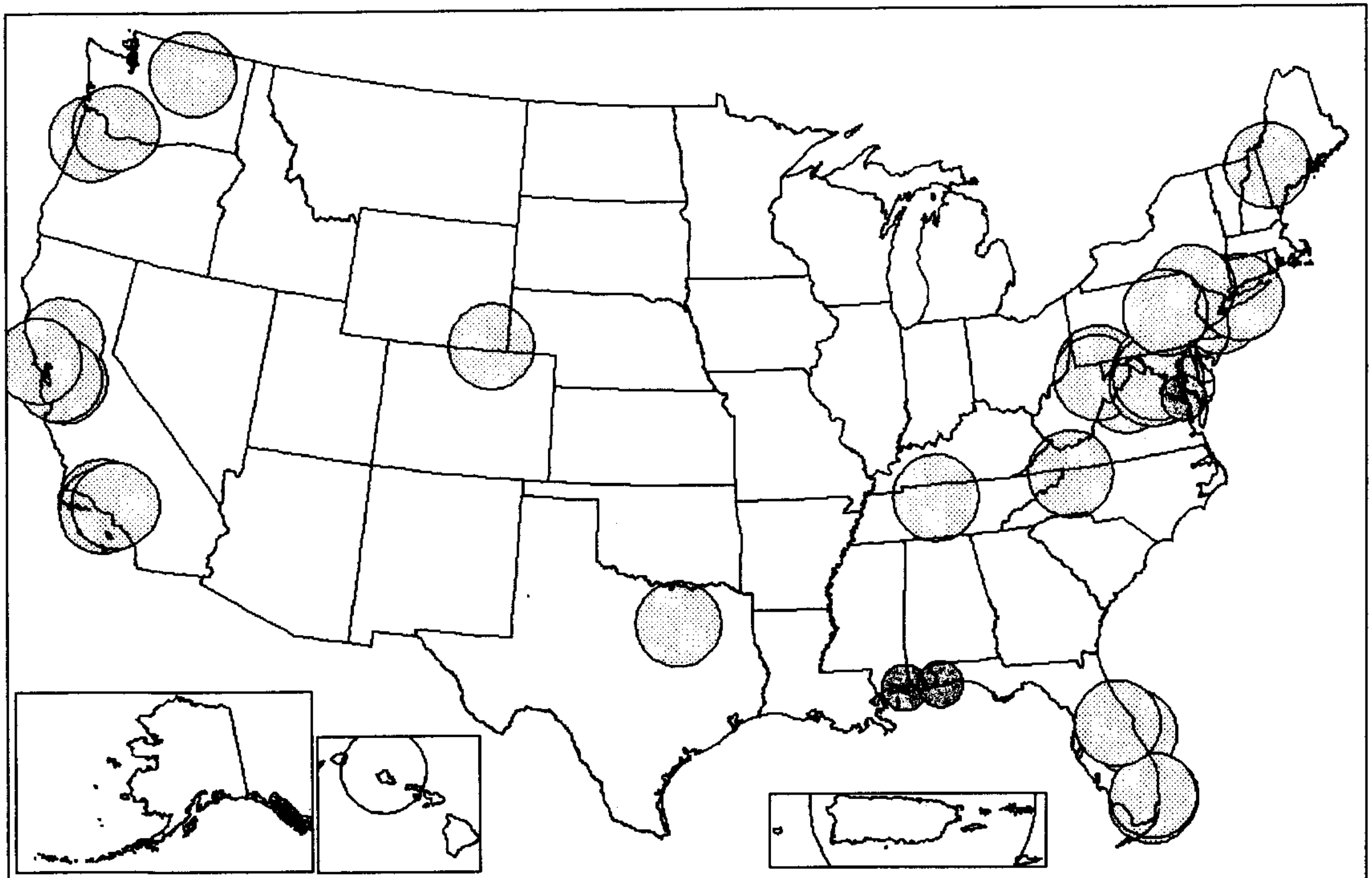
State	City	Latitude	Longitude	NAD*	Call Sign	Filenumber	Licensee
CA	Chatsworth	34°14'20.70"N	118°34'11.50"W	83	E000326	SESMOD2000112902256	McKibben Communications
CA	Livermore	37°45'40.00"N	121°47'53.00"W	n/s	KA232	SESLIC1997103001576	Sprint Communications Company, L.P.
CA	Malibu	34°4'52.60"N	118°53'52.90"W	83	E980066	SESMOD2000112902218	AT&T Corp.
CA	Malibu	34°4'50.30"N	118°53'46.40"W	n/s	KA273	SESRWL2000072401194	AT&T Corp.
CA	Malibu	34°4'49.70"N	118°53'43.90"W	27	KA91	SESMOD1998081701067	AT&T Corp.
CA	Malibu	34°4'51.00"N	118°53'44.00"W	27	KB32	SESMOD1998081701066	AT&T Corp.
CA	Mountain House	37°45'0.70"N	121°35'37.80"W	83	KA206	SESMOD2000022200272	Pacific Satellite Connection, Inc.
CA	Mountain House	37°45'1.70"N	121°35'38.80"W	83	KA86	SESMOD2000022200265	Pacific Satellite Connection, Inc.
CA	Salt Creek	38°56'20.20"N	122°8'48.00"W	n/s	KA371	SESRWL1999101201864	AT&T Corp.
CA	Salt Creek	38°56'21.00"N	122°8'49.20"W	27	KA372	SESRWL2003103101527	AT&T Corp.
CA	Salt Creek	38°56'22.30"N	122°8'49.60"W	n/s	KA373	SESRWL2000121502350	AT&T Corp.
CA	San Ramon	37°45'39.70"N	121°47'56.80"W	83	E6241	SESMOD2000112902270	Sprint Communications Company L.P.
CA	Somis	34°19'31.00"N	118°59'41.00"W	27	KA318	SESRWL2002030500275	SES Americom, Inc.
CA	Sylmar	34°18'55.00"N	118°29'12.00"W	83	E6148	SESRWL2004102901607	FiberSat Global Services, LLC
CA	Sylmar	34°19'4.00"N	118°29'0.00"W	27	KA274	SESRWL1999022500279	Globecast North America Incorporated
CA	Three Peaks	38°8'51.90"N	122°47'38.00"W	83	E950208	SESMOD2001032600656	Loral Spacecom Corporation
FL	Medley	25°51'19.00"N	80°19'52.00"W	n/s	E960068	SESLIC1995120700087	Teleport Of The Americas, Inc.
FL	Medley	25°50'26.00"N	80°19'3.00"W	27	E960406	SESMOD1999042201041	Globecast North America Incorporated
FL	Melbourne	28°5'10.00"N	80°38'10.00"W	n/s	E950276	SESMOD2003051500668	Harris Corporation
FL	Melbourne	28°2'25.00"N	80°35'48.00"W	27	KA354	SESLIC1995032300008	Melbourne International Communications Limited
FL	Miami	25°55'33.30"N	80°13'16.20"W	83	E980299	SESMOD2000072101188	USA Teleport, Inc.
FL	Miami	25°48'35.00"N	80°21'10.00"W	83	KA407	SESRWL2004030500317	Americasky Corporation
FL	Miami	25°48'35.00"N	80°21'11.00"W	n/s	KA412	SESRWL2004042200574	Americasky Corporation
FL	Miramar	25°58'32.00"N	80°17'0.00"W	n/s	E960105	SESLIC1995122600010	GEMS International Television
FL	Orlando	28°25'29.00"N	81°7'21.00"W	27	KA280	SESRWL2000101902129	Sprint Communications Company L.P.
GU	Pulantat	13°25'0.00"N	144°44'57.00"E	n/s	KA28	SESLIC1997081401122	MCI WORLDCOM Network Services, Inc.
GU	Pulantat	13°25'5.20"N	144°45'5.70"E	83	KA326	SESMOD2000120102250	MCI WORLDCOM Network Services, Inc.
HI	Haleiwa	21°40'14.60"N	158°2'3.10"W	83	KA25	SESMOD2003051300642	Intelsat LLC
HI	Paumalu	21°40'27.00"N	158°2'16.00"W	27	KA265	SESMOD2002040500579	Intelsat LLC
HI	Paumalu	21°40'15.50"N	158°2'6.10"W	83	KA266	SESMOD2004081801190	Intelsat LLC

State	City	Latitude	Longitude	NAD*	Call Sign	Filenumber	Licensee
HI	Paumalu	21°40'14.10"N	158°2'6.10"W	83	KA267	SESMOD2004081801191	Intelsat LLC
HI	Paumalu	21°40'25.00"N	158°2'16.00"W	27	KA268	SESMOD2002040500583	Intelsat LLC
HI	Paumalu	21°40'24.00"N	158°2'16.00"W	27	KA269	SESMOD2004042900611	Intelsat LLC
HI	Paumalu	21°40'24.00"N	158°2'16.00"W	27	KA270	SESMOD2004011300031	Intelsat LLC
MD	Clarksburg	39°13'5.60"N	77°16'12.40"W	27	KA259	SESMOD2002040500569	Intelsat LLC
MD	Clarksburg	39°13'5.00"N	77°16'12.00"W	27	KA260	SESMOD2002040500571	Intelsat LLC
MD	Clarksburg	39°13'2.60"N	77°16'10.90"W	83	KA261	SESMOD2003040200453	Intelsat LLC
MD	Clarksburg	39°13'1.80"N	77°16'11.40"W	83	KA262	SESMOD2003040200454	Intelsat LLC
MD	Clarksburg	39°13'4.40"N	77°16'13.90"W	83	KA263	SESMOD2004040800539	Intelsat LLC
MD	Clarksburg	39°13'5.20"N	77°16'13.90"W	83	KA264	SESMOD2004040800538	Intelsat LLC
MD	Clarksburg	39°13'7.00"N	77°16'12.00"W	83	KA275	SESMOD2003051300641	Intelsat LLC
ME	Andover	44°38'1.20"N	70°41'51.30"W	83	E000306	SESLIC2000062201004	MCI WORLDCOM Network Services, Inc.
ME	Andover	44°38'1.20"N	70°41'51.30"W	83	E000700	SESLIC2000113002229	MCI WORLDCOM Network Services, Inc.
ME	Andover	44°37'58.00"N	70°41'54.00"W	n/s	KA349	SESMOD1997060300716	MCI WORLDCOM Network Services, Inc.
ME	Andover	44°37'58.20"N	70°41'55.30"W	83	KA386	SESRWL2003102101443	MCI WORLDCOM Network Services, Inc.
ME	Andover	44°38'0.00"N	70°41'55.00"W	27	WA20	SESRWL2003091701297	MCI WORLDCOM Network Services, Inc.
ME	Andover #6	44°37'58.20"N	70°41'55.30"W	83	E930190	SESRWL2003062400894	MCI WORLDCOM Network Services, Inc.
NC	West Jefferson	36°25'50.00"N	81°23'45.00"W	n/s	E970334	SESLIC1997052700684	Infotel International Services, Inc.
NJ	Carpentersville	40°38'39.00"N	75°11'29.00"W	27	E7541	SESMOD2000113002268	Lockheed Martin Corporation
NJ	Carteret	40°34'44.70"N	74°13'0.50"W	83	E950361	SESMOD2000080801394	All Mobile Video, Inc.
NJ	Carteret	40°34'45.40"N	74°12'59.50"W	83	E950372	SESMOD2000080801390	All Mobile Video, Inc.
NJ	Franklin	41°7'4.00"N	74°34'33.00"W	n/s	E6777	SESLIC1999031200365	Sprint Communications Company, L.P.
NJ	Franklin	41°7'4.00"N	74°34'33.00"W	n/s	KA231	SESRWL1997062300835	US Sprint Communications Company L.P.
NY	Hauppauge	40°49'15.40"N	73°15'48.40"W	83	E950436	SESMOD2002030700321	Reuters America, Inc.
NY	Hauppauge	40°48'53.60"N	73°14'18.40"W	83	E970361	SESMOD2000112202201	Globecomm Systems, Inc.
OR	Moores Valley	45°20'32.40"N	123°17'19.40"W	83	KA365	SESLIC2003100201362	Neptune Pacific License Corporation
PA	Catawissa	40°53'39.00"N	76°26'21.00"W	27	E980493	SESMOD2000112902217	AT&T Corp
PA	Hawley	41°27'51.00"N	75°7'47.90"W	27	E950209	SESMOD1996073100731	Loral Spacecom Corporation
PA	Roaring Creek	40°53'35.90"N	76°26'22.60"W	n/s	KA444	SESRWL2002041800608	AT&T Corp.
PA	Roaring Creek	40°53'37.50"N	76°26'21.80"W	27	WA33	SESRWL2004032300452	AT&T Corp.
PR	Carolina	18°26'0.00"N	65°59'35.00"W	27	KA377	SESRWL2003071000942	Americom Government Services, Inc.
PR	Humacao	18°9'5.00"N	65°47'20.00"W	n/s	E872647	SESRWL2000091201765	Telecommunicaciones Ultramarinas de Puerto Rico
PR	San Juan	18°26'47.00"N	66°3'58.00"W	27	KA466	SESLIC1995030600004	Telecommunicaciones Ultramarinas de Puerto Rico
TN	Nashville	36°14'5.70"N	86°45'21.40"W	n/s	E960050	SESLIC1995101100315	Northstar Studios, Inc.

State	City	Latitude	Longitude	NAD*	Call Sign	Filenumber	Licensee
TN	Nashville	36°14'5.70"N	86°45'19.40"W	n/s	E960073	SESLIC1995101700295	Northstar Studios, Inc.
TN	Nashville	36°14'6.20"N	86°45'20.40"W	n/s	E970010	SESLIC1996100800361	Northstar Studios, Inc.
TX	Desoto	32°37'48.00"N	96°50'32.00"W	n/s	KA306	SESRWL2002030300266	Megastar Inc
VA	Alexandria	38°47'38.00"N	77°9'46.00"W	27	E970267	SESMOD2004070200978	SES Americom, Inc.
VA	Alexandria	38°47'36.00"N	77°9'59.00"W	27	KA81	SESMOD1998071701970	SES Americom, Inc.
VA	Bristow	38°47'1.60"N	77°34'24.30"W	83	E000152	SESMOD2004020900202	New Skies Networks, Inc.
VA	Bristow	38°47'2.40"N	77°34'21.90"W	83	E000696	SESMOD2003102801506	New Skies Networks, Inc.
VA	Quicksburg	38°43'45.40"N	78°39'25.10"W	83	E000589	SESLIC2000082401509	MCI WORLDCOM Network Services, Inc.
VA	Quicksburg	38°43'45.40"N	78°39'25.10"W	83	E010140	SESLIC2000113002478	MCI WORLDCOM Network Services, Inc.
VA	Quicksburg	38°43'45.40"N	78°39'24.20"W	83	E990175	SESMOD2000113002226	MCI WORLDCOM Network Services, Inc.
VA	Reston	38°57'0.00"N	77°22'40.00"W	n/s	E950406	SESLIC1995062900762	Sprint Communications Company, L.P.
WA	Brewster	48°8'51.00"N	119°41'29.00"W	n/s	E960222	SESLIC1996022101766	SES Americom, Inc.
WA	Brewster	48°8'49.00"N	119°41'28.00"W	27	KA20	SESRWL2002110601960	SES Americom, Inc.
WA	Brewster	48°8'51.00"N	119°41'29.00"W	n/s	KA294	SESRWL2003072201015	SES Americom, Inc.
WA	Yacolt	45°51'46.40"N	122°23'44.30"W	83	KA221	SESMOD1999082001537	MCI WORLDCOM Network Services, Inc.
WA	Yacolt	45°51'45.50"N	122°23'43.80"W	83	KA323	SESMOD1999082001536	MCI WORLDCOM Network Services, Inc.
WV	Albright	39°34'7.00"N	79°34'45.00"W	27	KA413	SESRWL2004060800805	AT&T Corp.
WV	Etam	39°16'50.00"N	79°44'13.00"W	n/s	KA378	SESRWL2001060801039	AT&T Corp.
WV	Etam	39°16'48.00"N	79°44'14.00"W	27	WA21	SESRWL2001060801038	AT&T Corp.
WV	Rowlesburg	39°16'52.10"N	79°44'10.70"W	n/s	KA351	SESRWL2002092301654	AT&T Corp
WY	Cheyenne	41°7'56.00"N	104°44'10.50"W	27	E950253	SESMOD2000050500706	Echostar North America Corporation
WY	Cheyenne	41°7'55.70"N	104°44'11.50"W	27	E980118	SESMOD2001111402151	Echostar North America Corporation

APPENDIX F: Protection Zones For Grandfathered FSS And Federal Government Stations

Protection Zones: 3650 to 3700 MHz



Small dark gray circles = Federal Government stations
Large light gray circles = Grandfathered FSS stations
Not displayed, Guam FSS stations

Federal Communications Commission
Office of Engineering And Technology

STATEMENT OF
CHAIRMAN MICHAEL K. POWELL

Re: In the Matter of Wireless Operations in the 3650-3700 MHz Band (ET Docket No. o4-151); Wireless Operations in the 3650-3700 MHz Band (WT Docket No. 05-96), Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band (ET Docket No. 02-380); Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band (ET Docket No. 98-237), Report and Order and Memorandum Opinion and Order

I am delighted that we are today opening this 50 MHz of spectrum for the provision of wireless broadband for consumers, especially in rural areas. This spectrum has been underutilized for far too long. The innovative rules we are adopting will make this spectrum available with minimal regulatory burdens. Thus, it should be attractive to entrepreneurial WISPs, community-based networks, and others interested in providing broadband in rural communities. With our flexible technical rules, this spectrum is also a potential home for new innovative technologies, such as WiMAX.

Identifying the best approach for this band has not been easy. The existing satellite earth stations and grandfathered Federal radar stations in this band must be protected. They severely curtail possible use of this spectrum to serve a substantial portion of the U.S. population. Coming up with an approach that provides the needed safeguards but still effectively allows new uses of the spectrum has been a difficult challenge – but a challenge that I am pleased that we have been able to meet.

Last April, we adopted a Notice of Proposed Rulemaking that took a hard look at 50 MHz of spectrum in the 3650-3700 MHz band. Since then, the Commission has received over a hundred comments about specific proposals that could potentially allow the use of unlicensed and or licensed terrestrial services in these bands. Today, we adopt a new approach that takes all of these views into account, and incorporates elements of both the Commission's licensed and unlicensed models in a hybrid approach that is best suited to the distinctive characteristics of this band.

I believe the Order carefully balances competing factors, minimizes the potential for harmful interference, and provides sufficient operating power and flexibility to help speed the introduction of new services to the marketplace. The streamlined licensing and registration process we adopt will provide additional spectrum for entrepreneurial WISPs for the expansion of wireless broadband services with minimal regulatory burdens. In addition, it will provide additional flexibility for a variety of base-station-enabled mobile terrestrial operations and protect incumbent grandfathered satellite earth stations and federal government radiolocation stations from harmful interference.

I commend the staffs of the Office of Engineering and Technology and the Wireless Telecommunications Bureau for their hard work on this complex item, working closely with their counterparts in the International Bureau. Only through these collaborative efforts have we been able to cut the Gordian Knot of the 3650 MHz band.

**STATEMENT OF
COMMISSIONER MICHAEL J. COPPS**

RE: Wireless Operations in the 3650-3700 MHz Band (ET Docket No. 04-151); Wireless Operations in the 3650-3700 MHz Band; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band (ET Docket No. 02-380); and Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band (ET Docket No. 98-237).

I'm hopeful that our actions in this item will lay the groundwork for much needed new broadband competition and additional broadband service to rural parts of the Country. To encourage this, we adopt a licensing system that draws much of its inspiration from the success of the unlicensed bands. While each operator will need an FCC license and will have to register fixed facilities, these licenses are not exclusive. Multiple licenses will be able to provide service in the same community, competing with one another or serving different types of customers. In this way, the system we create today is much like the system we use in the unlicensed bands. Entrepreneurial, municipal and mesh networks can begin operation without the heavy financial burden of an auction and competition will not be limited by the use of exclusive licenses. Auctions and exclusive licenses are powerful tools that have given us great success in other bands and we should not retreat in our use of these tools. But these devices do not always best serve every band, technology, and business plan, as the Commission finds today.

Unlike the unlicensed bands, however, we allow higher power use and establish tools by which licenses can avoid or correct interference. First, each licensee must include technology within its network that is designed to avoid interference. This, we hope, will avoid much of the interference possible when multiple high power systems operate along side one another. Second, each licensee will know the location of each other licensee because of the registration system, reducing the costs associated with identifying potential interference sources and allowing better initial system designs. Therefore, while there is no first-in-time interference protection, licensees can engineer their systems to avoid mutually destructive interference between new and existing systems. Additionally, every licensee has the responsibility, when contacted by another licensee asserting that they are suffering interference, to work with them in good faith to resolve the interference. If a licensee believes another licensee is intentionally interfering or breaching this good faith responsibility, they can come to the FCC.

Importantly, we also exclude licensees from operations in areas where government facilities and satellite operations are likely to receive harmful interference. Fixed facilities will not be allowed in these areas. Mobile devices will not be able to operate when brought into these areas because all mobile equipment must be able to receive a usable signal from a fixed transmitter before itself transmitting. This will ensure that they cannot wander into restricted areas. These restricted areas will significantly reduce the ability for the 3650 band to bring competition into parts of the Country, but avoiding harmful interference to government and satellite operators is critical. Additionally, satellite and new terrestrial operators have the responsibility to work in good faith to find ways of allowing new terrestrial use even in these restricted areas where possible. I hope that this will result in some technical agreements in these areas.

This is an innovative approach, and I congratulate OET and WTB for their hard work.

STATEMENT OF
COMMISSIONER JONATHAN S. ADELSTEIN

Re: *Wireless Operations in the 3650-3700 MHz Band (ET Docket No. 04-151); Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band (ET Docket No. 02-380); and Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band (ET Docket No. 98-237); Report and Order and Memorandum Opinion and Order*

In many respects, this is a bold decision. Based on some circumstances unique to the 3650-3700 MHz band, our decision bucks conventional wisdom, and puts in place rules and procedures that are intended to maximize multiple licensed users sharing spectrum in the same geographic area. While not a traditional "unlicensed" model, we have taken appropriate steps to significantly lower barriers to entry. The approach we are taking here should make it much easier for this spectrum to get in the hands of people who are ready and willing to use it.

This follows in the footsteps of our decision in the 70/80/90 GHz proceeding that also broke new ground in our approach to spectrum licensing. I think this reflects a positive trend at the Commission. We need to find the right balance between a licensing model for traditional, area-wide mobile systems, and a model for services such as those proposed for the 3650-3700 MHz band – a band that ultimately may serve a different user group, one that often is driven by more localized, community based needs.

We want to take advantage of the WiFi movement and take it to another level. I realize that we could not do everything the mesh network community had hoped for – we had to ensure that incumbents are properly protected – but we put in place a regime that doesn't rely on first in time and provides equal access to all.

I support our decision today. Of course, only time will tell if the novel decisions we make here result in increased use of this encumbered spectrum band. But I think that given the success of unlicensed wireless networks, we are on the right track, and our creative spectrum management approach is well justified.